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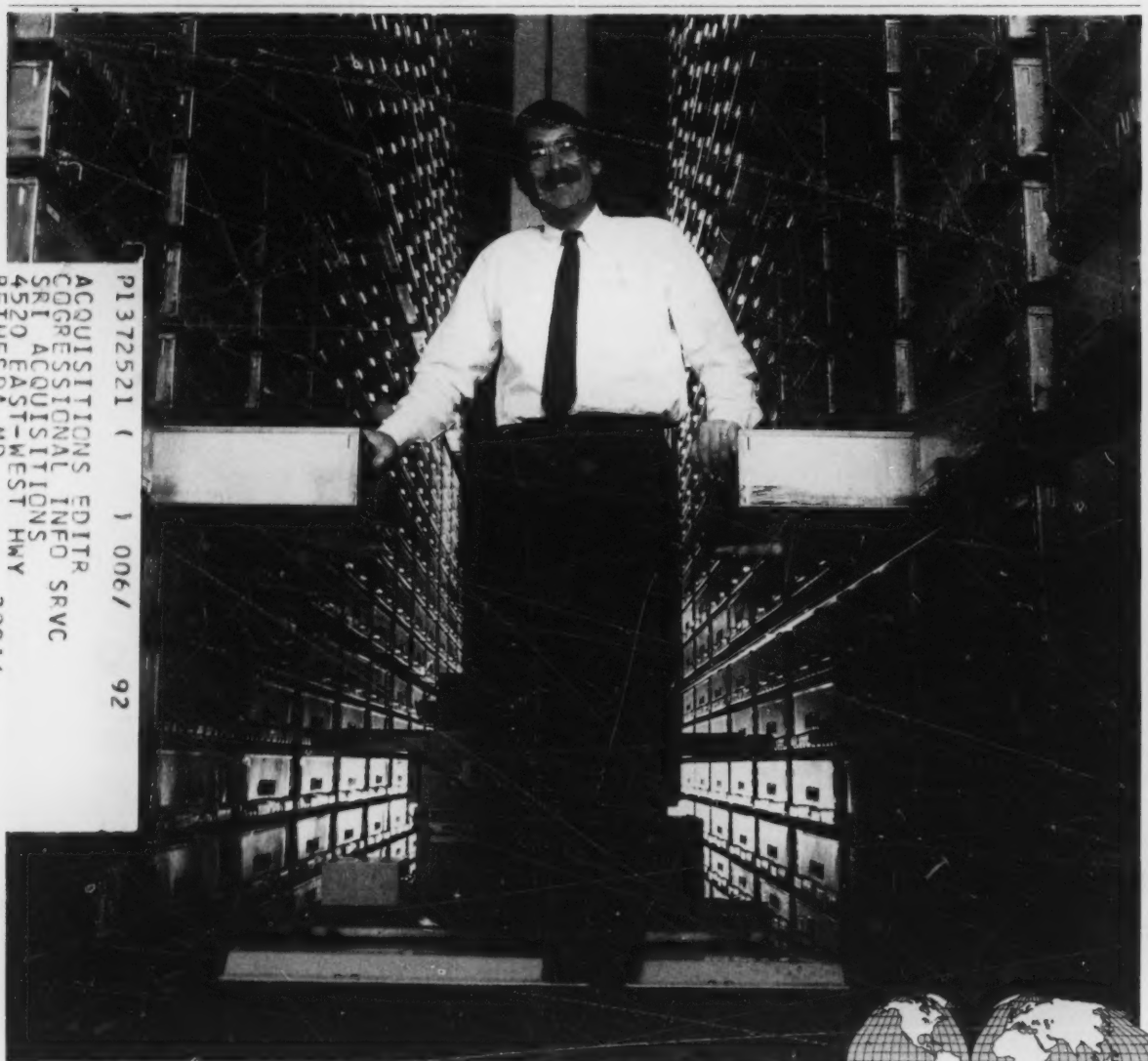
MAY 1, 1987

SIX DOLLARS

Electronic Business

IC equipment makers: Wiser, leaner and more businesslike

Fastest growing companies: The ones to watch in 1987



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Arrow's Stephen Kaufman: Managing the ups and downs of distribution

International directory of sites and facilities

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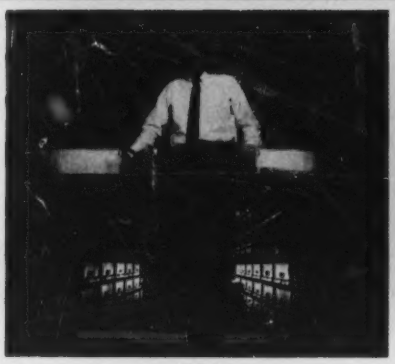
THE BUSINESS MAGAZINE FOR THE ELECTRONICS INDUSTRY

PAGE 28



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Cover photo/Jonathan Levine

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VBPA ABP

All signs point to a stronger second half

Distributors have hung on during tough times. Now look for a modest recovery in key markets

Everyone in the distribution business is forecasting a recovery this year but no one is expecting anything of monumental proportions. Still the signs of better days are already here. The first quarter started slowly but ended strongly. Anthony Hamilton, chairman of top-ranked Avnet Inc., expects a slow revival this year and a great 1988. Most industry watchers agree about 1987, but there is less certainty about 1988.

"There is a lot of optimism right now," says Craig Conrad, vice president of semiconductor marketing for Schweber Electronics Corp., referring to the semiconductor outlook. Schweber, he says, is planning for between 6% to 8% growth for 1987 in semiconductors, but the suppliers are looking at closer to 15% for the year. This is significant because, according to the Semiconductor Industry Association, the distribution share of suppliers' IC shipments hit record highs in 1986.

However, plenty of chips that were shipped stayed on distributors' shelves last year, and distribution margins were razor thin. Now, inventories are way down, margins are improving and leadtimes are stretching out. The National Electronic Distributors Association's book-to-bill ratio (for all products, not just integrated circuits) hit 1.11 in February, the highest value since May 1984. Shipments fell slightly last December but have picked up strongly in the first quarter of this year.

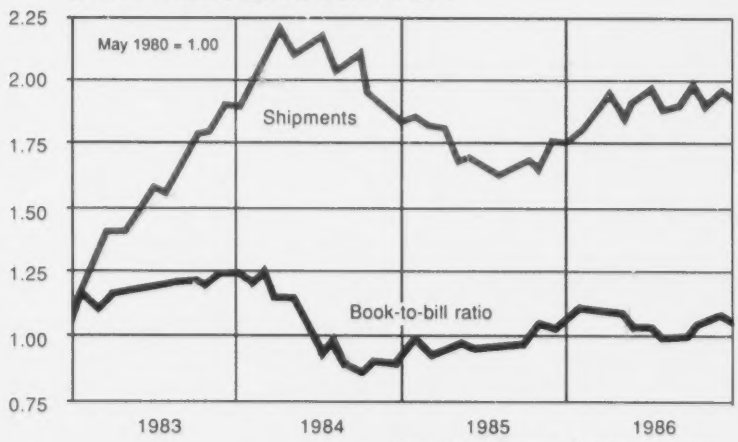
"The unusual thing about this uptick in semiconductor business is that it is supplier led and not distribution led," says Conrad. This is further evidence that this recovery could be substantive. "The suppliers have basically seen four to five months of strong bookings, and distribution hasn't really seen anything, except in the last couple of months," he says. The availability and capacity are there at the supplier level, and the inventory levels are significantly lower as well.

Combining the domestic recovery with the drop in the dollar could mean Japanese commodity chips will have a tougher time in the U.S. market. But agreements between Intel Corp. and Samsung, and also Motorola Inc. and Toshiba, imply a recognition that nationalist distinctions are not always in the best interest. These new international relations could mean another round of musical franchises: hardly a stabilizing influence at this time.

Stephen Kaufman, president and chief executive at Arrow Electronics Inc., believes that where the product is made and whose name is on it is really not important. What is important is that the Japanese and the Koreans have established a strong cost-competitive and product-quality position in some semiconductor lines, and Kaufman and other distributors would like to carry those products.

BRUCE C.P. RAYNER

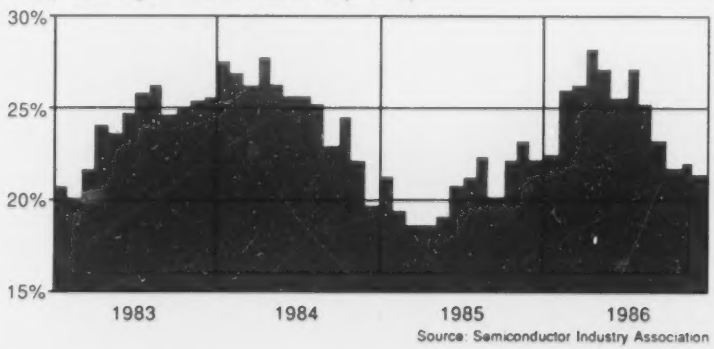
Distribution business index



Source: National Electronic Distributors Association

Distributors' share of IC shipments

(Percentage of U.S./Canadian shipments)



Source: Semiconductor Industry Association

Steady growth expected

The United States Index of Industrial Production, a coincident indicator of the U.S. economy, has been climbing steadily since the summer of 1986. The fourth quarter was up 0.7% from the prior quarter bringing yearly production up 1%. This year, modest gains are expected to continue through midyear with sharper increases in industrial production expected in the third and fourth quarters.

The Cahners Early Warning Indicator (CEWI) is a weighted average of housing starts, the Dow Jones Industrial Stock Index and the money supply (M2) — deflated by the Consumer Price Index. It forecasts probable business cycles about 12 months in advance. The black curve is a plot of the 12-month rate of change Index of Industrial Production. That is, its change over a 12-month period can be determined by comparison with the line at 100. For example, the 104.1 level forecast using the CEWI for the end of this year indicates that the average for all of 1987 should be 4.1% above 1986.

Readers can obtain a brochure explaining the CEWI method from Cheryl Patstone, economist, Cahners Economics Department, 3021 Tisch Way, Suite 100, San Jose, Calif. 95128.

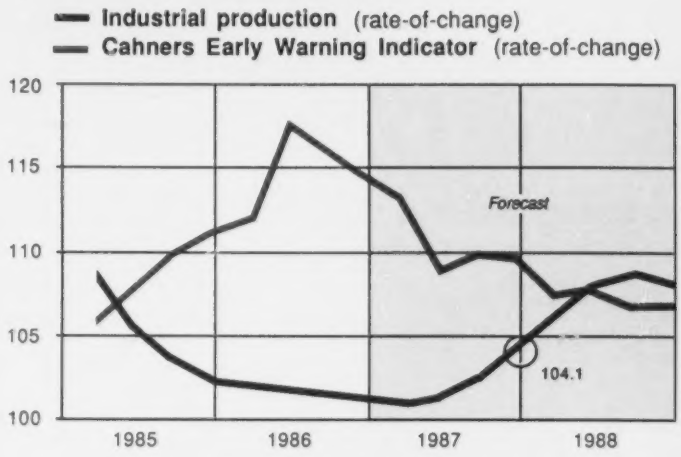
Electronic components

Component production, which was relatively flat in the first three quarters of 1986, jumped 2% during the fourth quarter and reached its highest level since mid-1985. But this advance came too late to prevent the market from posting an annual loss of 5.4%. The outlook for 1987 is much brighter, since major component users (such as the computer and telecommunications industries) are finally seeing an improvement in business. By the end of the year, component production should be running more than 15% ahead of the level at the start of 1987, and this brisk uptrend will lead to an overall annual growth of 10.3%. A gain of 18.2% is expected in 1988.

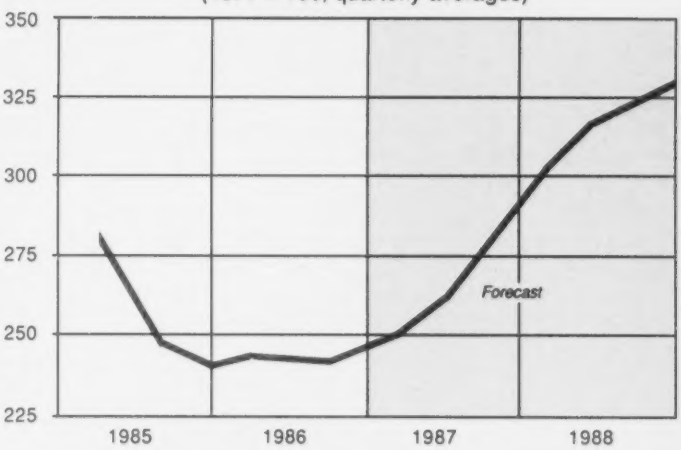
Equipment, instruments and parts

Production of scientific and engineering instruments grew 2.3% in the fourth quarter of 1986, after a lackluster performance earlier in the year. This spurt in activity lifted the yearly growth rate to 4.2%, nearly double the 2.2% pace for 1985. Much of the expansion in 1986 was focused in the areas of defense equipment and medical electronics. In 1987, the source of growth is expected to shift toward industrial-related segments such as process controls and electronic test and measurement equipment. Look for production to show an overall gain of 4.9% (in real terms) this year, with much of the improvement coming in the second half. Growth will accelerate 10.2% next year.

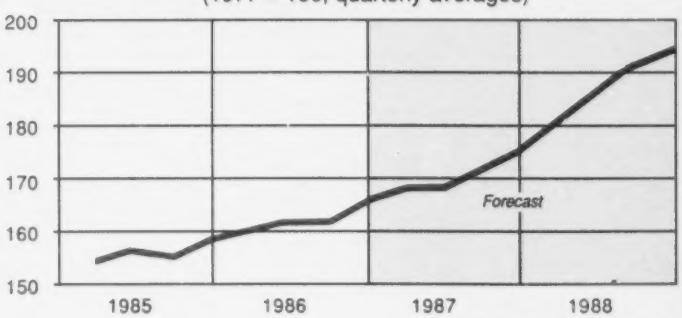
Economic indicators



Industrial production: Electronic components
(1977 = 100, quarterly averages)



Industrial production: Equipment, instruments and parts
(1977 = 100, quarterly averages)



Historical data: Federal Reserve Board
Forecast: Cahners Economics

New orders

Component manufacturers received an estimated $10.02 billion in new orders in 1986's fourth quarter, up from an $8.72 billion for the previous quarter. This rise resulted in part from distributors and original equipment manufacturers restocking their inventories in anticipation of improved business conditions this year. The U.S. industrial sector is now several months into an expansion and is expected to sustain the rise throughout 1987. This will help to push component demand higher as the year progresses. Orders, which rose 7.9% to $38.8 billion in 1986, are expected to increase at a slightly faster 12.9% in 1987.

Unfilled orders

Manufacturers' order backlogs averaged just $14.8 billion in last year's fourth quarter, the lowest level since mid-1983 and down from a $15.5 billion figure in the third quarter. On a yearly basis, backlogs shrunk 8.5%, a disappointment to manufacturers since it followed on the heels of a steep 20.6% loss in 1985. Now that the order slump appears to be over and industrial markets are getting back on solid footing, backlogs should once again begin to build, probably during the first half of this year. Backlogs are expected to reach an annual average of $17.1 billion for 1987, up 9.9%.

Shipments

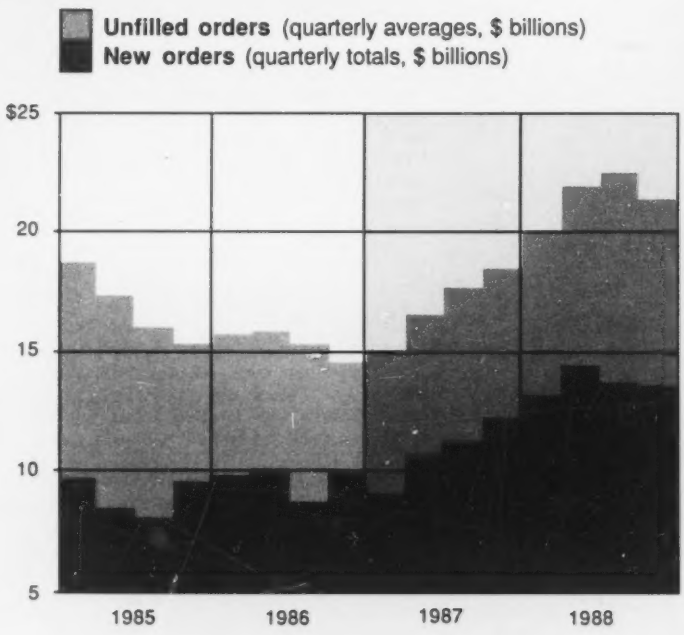
Fourth quarter shipments of electronic components were valued at $9.89 billion, up slightly from $9.74 billion in the previous quarter and 6.8% ahead of the year-ago pace. Annually, shipments reached $39.6 billion, a gain of 1.8%. The year-end turnaround in orders and expectations of improvement in the U.S. industrial sector over the course of 1987 makes the outlook for the next 12 months somewhat brighter. After a slow start in the first quarter, shipments are expected to rise more rapidly in mid-to-late 1987. For the year, shipments are forecast to increase 7% to $42.4 billion.

Inventory-to-shipment ratio

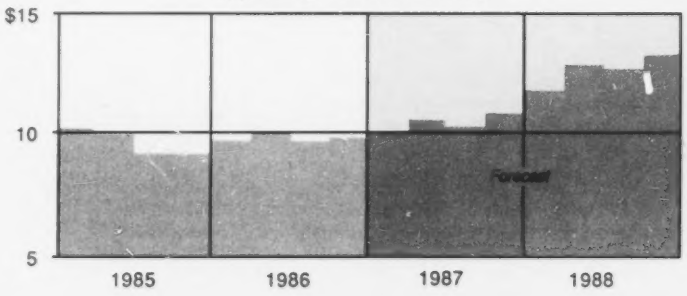
The inventory to shipment ratio for components continued to decline in last year's fourth quarter, reaching an average of 1.77. This was the lowest level since year-end 1984 and was well below the peak for this cycle (2.02) which occurred in June 1985. When the ratio is high it usually means that manufacturers need to liquidate inventory; when low, it may indicate a need for replenishment. Readings for late 1986 (and preliminary reports for early 1987) suggest that inventories are at a lean but reasonable level for this stage of a business expansion. The I/S ratio is expected to edge down slowly over the next 18 to 24 months, as it typically does when business conditions are improving.

Electronic components

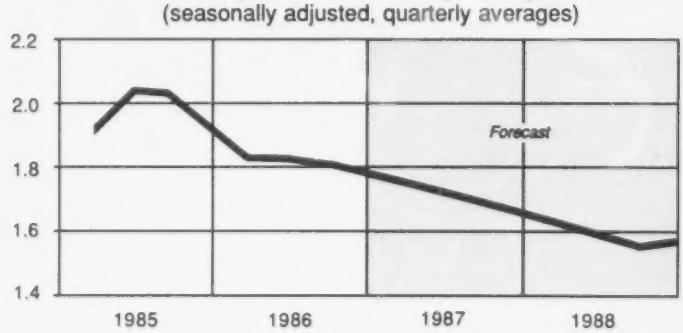
(SIC 367)



Electronic components: Shipments
(quarterly totals, $ billions)



Electronic components: Inventory-to-shipment ratio
(seasonally adjusted, quarterly averages)



Historical data: U.S. Department of Commerce
Forecast: Cahners Economics

most," says General Lew Allen Jr., head of the NAS study group and former director of the National Security Agency. "But the impact on business is not unimportant," he adds.

Industry officials agree with the NAS that it is a mistake to equate the loosening of export controls with a disregard for national security. "Our members are as concerned as anyone else," says CBEMA's Maxwell. "We all have a common goal. We are all Americans." Concurs Dwight of Spectra-Physics: "What we're trying to do is build higher fences over a limited number of products and still deny the Soviets anything truly detrimental to our national security."

The High Technology Trade Promotion Act, introduced by Frenzel and AuCoin, would, among other things, eliminate the Defense Department's "de facto veto" — also a recommendation of the NAS panel. The legislation would reaffirm the role of the Commerce Department as the ultimate authority in processing export licenses. It would also eliminate requirements for: export licenses on high-tech items shipped to U.S. allies; reexport licenses for products exported to and imported from allied countries; and export and reexport licenses on low-technology products shipped to and from other Western countries.

Commerce, meanwhile, has implemented internal reforms of its own including: proposed implementation of new general licenses that reduce the licensing burden for U.S. exporters and CoCom partners; plans to revise its parts and components regulations to address the de-Americanization problem; elimination of licensing requirements for low-level exports to non-CoCom countries in the West, and reduction or elimination of the need for U.S. authorization for reexports into CoCom countries.

Commerce also has proposed legislation that when a product or technology similar to a U.S. product is available to another Western country without restrictions, that U.S. product qualifies for a license to that country. That license would be granted in 20 days unless an unacceptable risk of diversion is shown. Moreover, Commerce says that this year it will meet President Reagan's goal of reducing license times by one-third — from 20 days to 14 days. Licenses for CoCom partners are processed in only about seven days.

In Commerce's legislative package, the department will provide authority to allow for exports to the People's Republic of China under the distribution license. Companies with distribution licenses are constantly monitored by Commerce and Defense and do not have to reapply for an export license every time they ship a product to an approved foreign customer.

That's good news for semiconductor equipment makers that have a distribution license. China is "potentially a very important market," says Ciesinski of SEMI. If the proposed legislation and other changes in the export control system do not become a reality, industry leaders worry that U.S. technology firms will continue to lose out to foreign competitors, both in emerging markets like China and even in the West. "The Japanese can do it. The Europeans can do it. And it won't be long before the Koreans can do it," worries Perrone. "We really have to limit restrictions to critical military technology. It's gotten to the point where there's a reason to deny anything."

BETH KARLIN

Currency fluctuations pave the way for U.S. exports

Despite export control problems, there's been a resurgence in electronics exports, especially to Europe

A year ago, Monolithic Memories Inc. was selling one of its programmable array logic (PAL) products for Fr18 to its French customers. Today, partly because of international currency fluctuations, that same device costs Fr10. As a result, the Santa Clara, Calif., semiconductor company has been able to gain market share against Japanese rivals offering PAL alternatives like gate arrays or transistor-to-transistor logic devices.

Like many other U.S. companies that have kept their manufacturing onshore, MMI is realizing the benefits of the overseas currency swings of the past two years. Although U.S. industry as a whole has seen only disappointing export gains, many U.S. component and computer firms are performing well in international markets, particularly Europe. Hewlett-Packard Co., for example, reported a 23% rise in international revenue and a 24% increase in international orders during the quarter ending January 31. Domestic revenue, by contrast, fell by 2% while domestic orders inched ahead by just 3%.

At Tektronix Inc., international revenue as a percentage of total revenue climbed from 36% to 41% last year. IBM's international business, up 20.2% in 1986, kept the armadas of Armonk afloat as domestic sales shriveled. Currency gains actually contributed $645 million to IBM's 1986 profits, according to chairman John F. Akers.

Overall, reports John McPhee, director of the U.S. Commerce Department's Office of Computers and Business Equipment, U.S. exports of computers and business equipment were up by 5% in 1986. But that modest gain masks the real story: a very forceful pickup in the second half of the year. After actually declining in the first half of the year, exports rose by 20.4% on $6.47 billion to $7.79 billion.

Although much has been made of the fact that the dollar has not weakened against the currencies of Korea and Taiwan, enabling these low-cost Asian producers to build their electronics bases, the simple truth is that these countries do not yet have the industrial capacity or broad product range of U.S. industrial rivals in Japan, France and Germany. It is also worth noting that three of Taiwan's top four exporters (Digital Equipment Corp., General Electric Co.'s RCA Corp. subsidiary and Texas Instruments Inc.) are U.S.-based firms [ELECTRONIC BUSINESS Dec. 10, 1986

p28]. Meanwhile, the declining value of the dollar against the yen, franc and deutsche mark has made U.S. product more competitive in Europe and indeed anywhere that the competition is Japanese, French or German.

Suddenly cast in the unfamiliar roles of low-cost producer and potential price leader, many U.S. electronics firms have had an interesting choice. Do they simply pocket their currency translation gains or do they pass them on to customers in the form of lower prices? This, in essence, is the inverse of the choice faced by Japanese exporters, who have had to decide between raising prices or lowering profit margins to retain market share. The Japanese, consistent with tradition, have sacrificed quarterly earnings to maintain market strength. But not all American firms have chosen to emphasize market share over profit.

Philosophic choices

Socket and connector maker Augat Inc. of Mansfield, Mass., for example, is not lowering prices. "Our philosophy is not to pass through the dollar impact in any case unless it's absolutely necessary for competitive and strategic circumstances," explains Stephen Gallant, manager of finance and administration for Augat's international division. Gallant says that if Augat cut its prices, others would simply follow suit. Besides, he adds, orders are "absolutely going great guns."

Many American companies have split the currency gains with their customers. John Fluke Manufacturing Co., for example, has lowered prices on some of its exports to Germany by roughly 25% during the time the German deutsche mark has appreciated by 50%. Even with such reductions, the Everett, Wash., instrument maker has come out a winner, according to vice president of international operations Ron Wambolt. Profits in Europe "were double what was budgeted" for the fourth quarter of 1986, according to Wambolt.

Monolithic Memories, in choosing to pass currency gains on to its customers, has opted for market share over profits. "We have tended to pass on the currency savings in an effort to hold on to and increase our market penetration," explains Bryan Rooney, MMI's director of international sales. (At press time ELECTRONIC BUSINESS learned that Rooney is now with Silicon Systems Inc.) In the case of the PAL product whose price has fallen from Fr18 to Fr10, about Fr4.5 of the drop is attributed to MMI's lowered costs as the product reached volume production. The rest — about Fr3.5

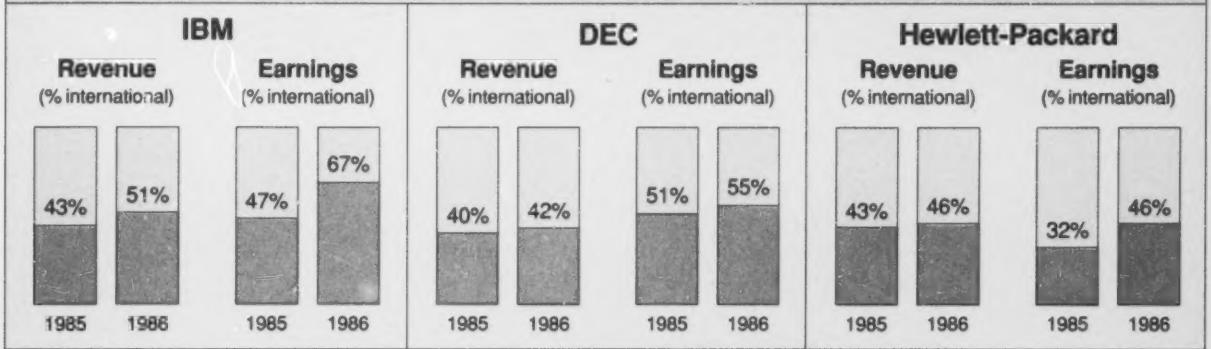
Exports of U.S. computer equipment are on the rise

U.S. domestic exports ($ thousands)

Country	1985 July - December	1985 Total	1986 July - December	1986 Total
Total	**$6,474,933**	**$13,964,031**	**$7,789,092**	**$14,669,276**
Canada	$1,011,608	$2,167,205	$940,287	$1,930,099
Latin America				
Brazil	$123,228	$248,232	$146,482	$274,441
Mexico	202,567	398,110	177,098	369,960
Venezuela	57,522	98,464	63,413	119,223
Total	$578,137	$1,099,094	$592,017	$1,124,057
Western Europe				
Austria	$22,296	$43,250	$26,297	$44,535
Belgium and Luxembourg	127,922	265,077	189,944	336,784
Denmark	29,105	69,780	44,101	73,764
France	376,506	848,247	475,455	892,960
Greece	3,930	12,038	6,783	13,110
Ireland	237,402	525,870	320,878	583,284
Italy	192,435	410,450	281,227	484,495
Netherlands	304,774	673,718	411,231	778,376
Sweden	92,775	186,290	98,803	191,545
Switzerland	91,726	235,625	123,904	224,322
Britain	785,169	1,747,814	945,415	1,813,937
West Germany	589,826	1,294,646	800,164	1,505,768
Total	$3,013,437	$6,654,711	$3,927,864	$7,340,478
East Asia				
Hong Kong	$131,467	$347,281	$143,673	$278,675
Japan	569,982	1,265,297	707,685	1,334,745
Philippines	18,542	32,513	18,143	37,334
Singapore	199,708	415,442	264,473	471,421
South Korea	101,382	200,318	153,616	242,405
Taiwan	106,788	223,715	147,848	264,468
Total	$1,267,694	$2,765,269	$1,638,502	$2,969,598
All other countries				
India	$27,140	$54,415	$48,325	$83,595
Israel	88,924	173,237	80,383	155,033
South Africa	50,683	118,180	63,360	123,404
Saudi Arabia	63,109	111,885	42,338	79,761
Total	$604,057	$1,277,752	$690,422	$1,305,053

Source: U.S. Department of Commerce

Computer giants profit from international sales surge



Source: International Data Corp.

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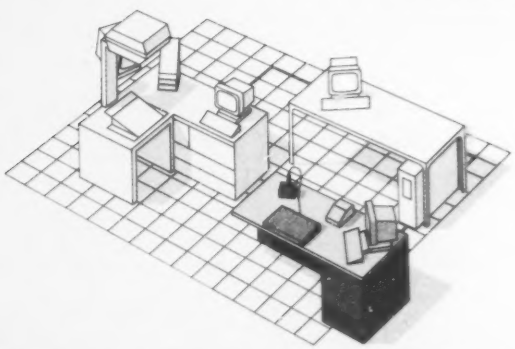

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— is the result of MMI's savings from producing in America and selling in France. "The customer is saving Fr3.5 purely as a result of currency rates," Rooney notes. Although the Japanese do not sell PAL products in Europe they do sell PAL alternatives like gate arrays. "Our objective is to make the PAL product family more competitive to other solutions." Rooney says MMI does sell bipolar programmable read-only memories in direct competition with Fujitsu and contends that the California producer "has gained share against Fujitsu in Europe" with these memory products.

Winners and losers

Interestingly, MMI and other smaller companies, which never built production facilities in Europe, are the ones gaining the full benefits of dollar weakness. Meanwhile, U.S. firms that built European plants are realizing diluted benefits. Augat, for example, has production in Switzerland as well as in the United States. "If you make product in the U.S. and sell it in Europe, Europeans can buy it up to 40% cheaper than they did one and a half years ago. However, if you're manufacturing in Switzerland, for example, as we do, the product costs approximately the same as it did a year and a half ago," explains Augat's Gallant.

The biggest losers from the global currency readjustments of the past 18 months have been the Japanese [ELECTRONIC BUSINESS Nov. 1, 1986 p76]. Of course, it is often forgotten that the remarkable Japanese ascendancy of the last half decade coincided with the strengthening of the dollar in the early years of this decade. Now they are seeing the other side of the coin. "I wouldn't call them a low-cost source anymore," says Richard Locke, manager of international procurement for Hewlett Packard Co.

HP, says Locke, now purchases monochrome monitors from Korea and liquid crystal displays from a Singapore supplier. These were only recently virtual monopoly markets for the Japanese, who are now competing more on the basis of technology than price, according to Locke. The fall of the dollar against European currencies has also put the brakes on HP's thrust toward buying European-made components for the systems it markets in Europe. Locke says U.S. suppliers are not yet winning back business from Europeans, but the pace of conversion to local content has slowed.

NORM ALSTER

Why monochrome monitors could make a comeback

Nobody's making money today in black-and-white monitors, but there may be a niche opening up in desktop publishing

Desktop publishing is hot — some might say "hyped." Doing publishing functions on a personal computer requires a little extra in the way of hardware, including a high-resolution black-and-white display. That is prompting a resurgence of activity by U.S. monochrome monitor makers, which provide the innards of those screens.

"Desktop publishing is definitely the big emerging market," says L. Richard Lemke, vice president of Dotronix Inc. The New Brighton, Minn., company makes high resolution black-and-white monitors for resale by makers of PC add-on boards. "Our initial thrust was CAD/CAM [computer-aided design and manufacturing] but the real volume is from publishing," Lemke says. He expects publishing will push his monitor sales up 30% to 50% this year and continue at that rate for another year or so.

Desktop publishing is also an important new market for Moniterm Corp. of Minnetonka, Minn. Until recently, Moniterm, which also makes monochrome monitors, sold only into the original equipment manufacturing (OEM) chain. Workstation customers include Computervision Corp. and Sun Microsystems Inc., according to James Walters, a Moniterm regional sales manager. Its first product under its own label is aimed specifically at design automation and publishing. Walters thinks there is the potential to upgrade as much as 5% to 10% of the IBM PC AT population to big screens.

One systems integrator that is riding the crest of the wave of demand for publishing systems is E-Machines Inc., a Tualatin, Ore., start-up that sells an add-on monitor and graphics board for Apple Computer Inc. hardware. Right now, E-Machines buys a big screen from Matsushita Electric Industrial Co.'s Panasonic subsidiary that it plugs into Apple's Macintosh personal computer. To date, E-Machines president Steven Vollum says he has sold over 1,000 displays for publishing. The primary reason for going with Panasonic, he says, is quality control. "As [Panasonic's monitors] roll off the boat, one after another, they're all the same," he says. "Our concern is: can a domestic supplier do that?"

Some system integrators warn, however, that the computer-aided publishing business may not develop as quickly as some industry experts think. Michael D'Agostino, vice president for marketing at Princeton Graphic Systems, a Princeton, N.J., subsidiary of Intelligent Systems Corp., notes, for example, that desktop publishing is, "almost, for the time being, a spur to the PC business." That may make for "an explosive area of growth" for the monochrome business, says D'Agostino, who buys his monitors from Liberty Electronics Co. in Taiwan. Right now, however, the software for publishing is still lacking. "The monitors are just sitting there," D'Agostino says, "The software is one and a half years behind the hardware."

Monochrome makers, particularly those in the United States, hope that the desktop publishing market turns out to be more than just a fad. The monochrome business "is not so profitable [because] the competition is getting too severe," notes D.K. Chung, manager of original equipment manufacturing (OEM) sales for Samsung Electronics America Inc. in Rancho Dominguez, Calif. Samsung is the No. 1 monochrome monitor supplier, shipping some 2 million units in 1985, according to Stanford Resources Inc.

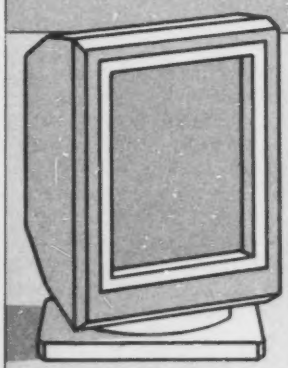
The "Four Tigers" of the Far East — Hong Kong, Singapore, South Korea and Taiwan — "created two, three times more in supply than what there was demand for," agrees David Lindstrom, president of Elston Electronics Corp., a leading OEM monitor supplier in Geneva, N.Y. "Nobody's making any money."

Even a giant like Hitachi Ltd. has moved away from the monochrome business to concentrate on higher margin color products, according to Thomas Klopcic, a marketing manager for Hitachi America Ltd.'s Electron Tube division in Schaumburg, Ill.

But Lindstrom hopes that he can boost Elston's business by doing short runs of custom monitors for U.S. systems integrators. He has almost convinced Vollum of E-Machines, who says he is considering Elston as a supplier. E-Machines has to rearrange the circuitry in the Panasonic monitor to fit Apple's Macintosh, which means it has to void the Panasonic warranty. "That's a problem with Panasonic — they absolutely won't customize for you," Vollum says.

DAVID CARD

Monochrome monitors



Worldwide production by region
(millions of units)

Region	1986	1987	1990
United States	1.7	1.9	2.4
Europe	0.9	1.0	1.2
Japan	2.4	2.6	3.2
Far East and others	9.5	10.1	13.1
Total	14.5	15.6	19.9

Worldwide consumption for computers
(thousands of units)

Resolution	1986	1987	1990
Low/medium	9,902	10,695	13,464
High/ultra-high	143	223	517
Total	10,045	10,918	13,981

Source: Stanford Resources Inc.

Hardware vendors adapt to a changing E-mail market

The $300 million electronic mail market is in flux, thanks to the emergence of a new standard: X.400

The U.S. market for electronic mail software and services — currently pegged at approximately $300 million — is about to experience a major shake-up, and possibly shakeout, thanks to a new standard known as X.400.

So far, however, vendors seem unsure what to do with X.400 — the universal E-mail interface which is part of the Open System Interconnection (OSI) data-interchange standard being hammered out by various national and international standards groups. All of them are at least monitoring developments connected with the evolution of the standard, a final version of which is undergoing review by a National Bureau of Standards committee. But to date, few have announced products which integrate or incorporate X.400. In part, companies say, they are holding off from announcing this capability so they can make sure their products are 100% compatible with the final version of X.400. IBM has announced, however, that it plans to offer a software program called X.400 Message Transfer Facility Program Offering, but it won't be available until the third quarter of 1988 and then only in Europe.

It's easy to justify costs with E-mail

But some E-mail firms also acknowledge that adoption of X.400, at least in theory, will enable unlimited access to competing E-mail services. Currently, customers choosing one vendor's product are locked into sharing information with customers and services which are part of that vendor's network. With unlimited access, "some competitors may feel they have very little to gain and a lot to lose," says Eric Arnum, editor of the "Electronic Mail and Microsystems" newsletter published by the Norwalk, Conn., market research firm, International Resource Development Inc.

"There's already a reluctance to share customer lists," Arnum explains. "Some companies fear their directories could become sales lists."

However, this fear has not stopped vendors — especially the public, or nonproprietary E-mail companies, such as CompuServe Inc., MCI Communications Corp., Western Union and others — from developing specific interfaces to individual (and many times directly competing) E-mail products. Western Union, for one, has developed interfaces between its EasyLink service and various proprietary E-mail products offered by Digital Equipment Corp., IBM and Wang Laboratories Inc., public E-mail networks in France and Japan, and the Telex network worldwide. Talks between Western Union and other public vendors about developing direct interfaces to their services continue "from time to time," adds Joseph Norton, assistant vice president of EasyLink product development for the Upper Saddle River, New Jersey-based company. It's more emotion than technology holding up their progress, he admits.

A growing number of private (or proprietary) vendors, too, are dabbling in interfaces between their products and other public and private E-mail facilities, especially IBM's Professional Office System (PROFS) and Distributed Office Support System (DISOSS).

Connectivity concerns

But E-mail companies hardly are providing these interfaces out of the goodness of their hearts. Customers are demanding connectivity. And in E-mail, when the customers talk, vendors listen — primarily because vendors have been largely unsuccessful in generating the widespread interest they originally anticipated.

"It's very easy to justify costs and benefits for E-mail, but companies still acknowledge they're having trouble selling it," says Krystyna Filistowicz, a research analyst for San Jose, California's Dataquest Inc. The lack of universal data-interchange standards is only partially to blame, she says. The failure by top management at many big corporations to decree implementation company-wide has also contributed to E-mail's limited success, she claims.

This top-down, corporate-wide mentality also explains why the biggest E-mail vendors continue to be the top computer vendors, which tend to offer E-mail as an inseparable part of their general office-automation software. IBM, with an installed base of 4,000 PROFS and DISOSS packages combined, is the leader, according to Arnum, followed by DEC, with 3,800 All-In-1 packages installed. Then comes Data General Corp., with 3,000 installed copies of its CEO product line. (Each of these installed packages represents multiple users, usually in the range of 30 or more.)

At least 35 to 40 U.S. computer and independent software vendors sell some type of E-mail integrated with other office-type software, Arnum estimates. With average prices for these total office-automation packages in the tens of thousands of dollars range, the E-mail portion of their sales should total about $100 million in 1987, he says.

Revenue of the 14 top U.S. public (or nonproprietary) E-mail vendors,

Marty Braun

on the other hand, should reach $270 million this year, Arnum says. These companies charge their customers a small fee (usually $1 or so) for each message they send, plus some type of annual user fee. Arnum cites Western Union's EasyLink as the largest public vendor transmitting seven million messages per month, followed by US Sprint/Telenet's Telemail at 2.2 million messages, and then MCI's MCI Mail at two million messages.

Homegrown E-mail systems are disappearing

X.400 impact

There is little current competition among the computer vendors, independent software vendors and public network vendors. "We can sell and market E-mail to death, but we won't change the economics of company decisions to go in house or public," confirms Western Union's Norton. Adds Shearon Arnott, director of information center product marketing for Applied Data Research Inc., a Princeton, N.J., database software and E-mail vendor owned by Ameritech: "IBM dominates this market, no matter how you cut it. And IBM doesn't give up market share very easily." Consequently, *Fortune* 500 companies have tended to be the almost exclusive domain of the private E-mail vendors, while the medium- and smaller-sized firms have typically gone with public E-mail vendors.

But with X.400 a lot of these givens could change, industry watchers say. In fact, a number of E-mail vendors already are gearing up for a more competitive marketplace. "More people are finding ways to justify E-mail for different reasons," says ADR's Arnott. "The market's growing. Companies that had homegrown E-mail systems are outgrowing them." In order to make its ADR/eMail product more appealing to users outside of its database management-software customer base, ADR recently introduced an interface to IBM's DISOSS program. By the end of the year, the company intends to introduce an interface to DEC's All-In-1, Arnott says, followed by similar ones to Wang, MCI Mail, Telex, and other data-interchange systems. At the same time, ADR is working to expand the breadth of its E-mail offering.

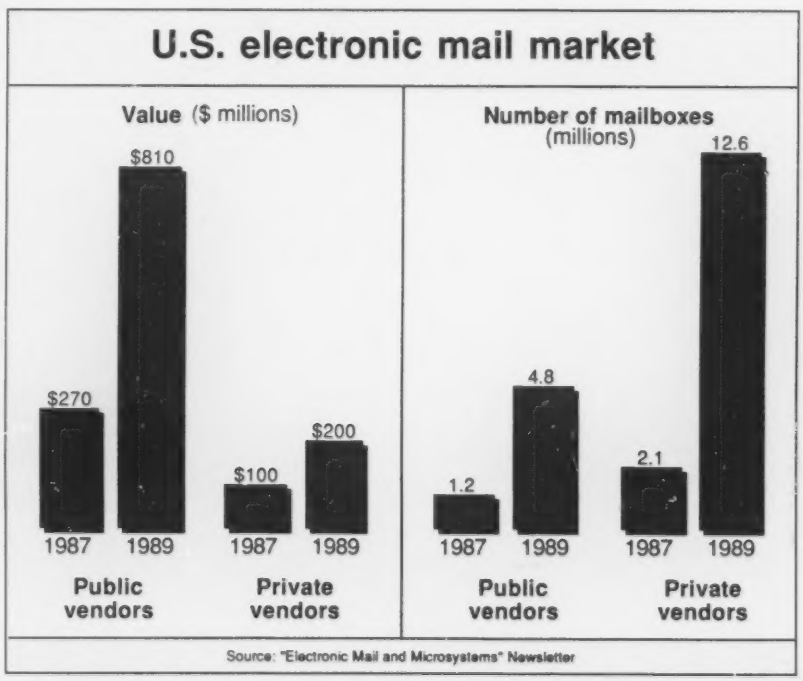
Meanwhile, Western Union is not resting on its laurels. The No. 1 public vendor plans to offer complete capabilities for X.400-compatibility by the end of 1987, Norton says. Sometime in the second quarter, EasyLink users will be able to transmit and receive binary-code files, including spreadsheets, databases, and other complete computer programs. It also plans to expand its current domestic facsimile delivery capability to a worldwide capability by the second quarter, Norton says.

Computer vendors, too, are scrambling. Wang introduced its first standalone E-mail product, Wang Office Mail, in January. The product is geared toward smaller companies, for which an electronic mail-only product is most easily cost justifiable, says Jackie Appel, manager of office applications product marketing.

Wang also is continuing to enhance the E-mail capabilities contained within its Wang Office integrated software, as well as its E-mail component of PC Office. As part of this strategy, Appel says, the company is further developing its integration capabilites — especially E-mail/voice mail integration. And, like other public and private E-mail vendors, Wang is developing links to other E-mail services. So far, it provides links to IBM's PROFS and DISOSS only. But through its third-party integration program, it is encouraging other vendors to employ its Application Program Interface subroutines to build links to Wang Office, she points out.

More than ever before, "customers are looking for a backbone to their office systems," Appel concludes. "E-mail is that backbone."

MARY JO FOLEY



Many Braun

IC equipment makers get down to business

The equipment industry is emerging from the recession with a new respect for the art of business and customer needs

By Mark Mehler

The $5 billion worldwide semiconductor equipment industry is emerging from the mire of a three-year recession wiser, trimmer and cognizant of its casualties, and determined to balance technological striving with good business practices. Now, if only the chip makers would start buying equipment again.

The semiconductor merchant vendors spent $1.685 billion on semiconductor-related capital expenditures in 1986, which represented a 21% decline from 1985's $2.125 billion, according to market researchers at Integrated Circuit Engineering Corp. in Scottsdale, Ariz. The researchers contend that each capital equipment dollar invested yields about $2 in additional annual sales for the chip makers.

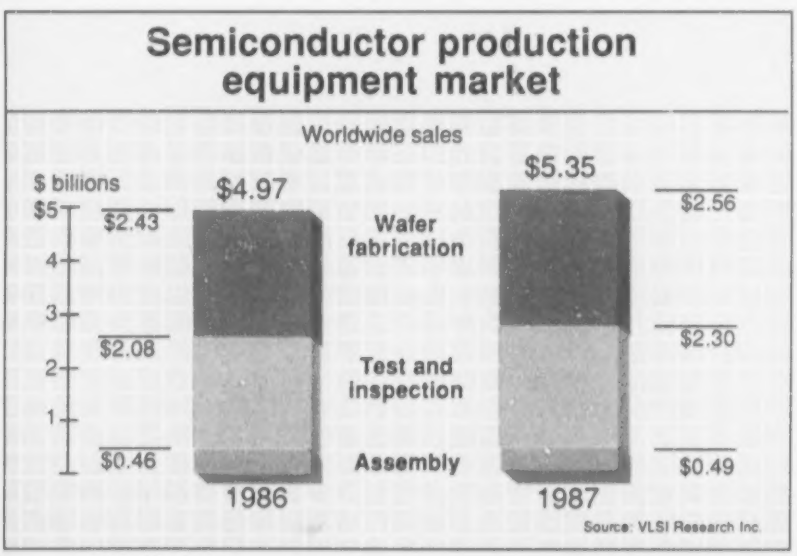
U.S. chip makers are also concerned with the future of their supplier base and some are calling for a new era of good feeling. "We are opening up our kimono," says Keith Erickson, director of materials for Intel Corp. Intel has been singled out by vendors for putting them through endless evaluations and for publicly praising Japanese equipment. Erickson says Intel hopes to end the "adversarial" relationship by forming tighter bonds with suppliers and doing whatever is feasible to shorten the pipeline and improve communications to avoid inventory problems caused by order cancellations. "The equipment suppliers did what we told them in [1984] and they got hurt," says Erickson. "We don't want that to happen again."

Mohan Rao, senior vice president at Texas Instruments Inc.'s Semiconductor Group, likewise calls for closer vendor-user relationships, noting historically, the equipment maker "hasn't been an integral part of the development of the process." Nevertheless, Rao envisions an inevitable shakeout among U.S. equipment companies that can't fund development of flexible systems. "The equipment industry needs an infrastructure," he says. "And we would like to see a reduction in redundancy."

Chip makers have also taken the initiative in the proposed Sematech manufacturing technology consortium that has embraced the concept of pursuing semiconductor manufacturing technology through a combined industry and government-sponsored research organization.

It may be difficult to find the silver lining in this market, but it does exist. There remains an astounding wealth of good semiconductor process technology and products among the estimated 2,500 worldwide suppliers of equipment and materials. Neither technical innovation nor the nerve to take risks is in short supply. What has contributed most to the IC equipment industry's three-year malaise is a breakdown in good business practices: poor balance sheets, inattention to customers' needs, faulty market forecasting, bad product marketing, and plain old-fashioned arrogance. Nearly every vendor owns up to these failures over the past 10 years and blames them for the present sorry state of the industry.

But, the equipment makers are by no means entirely responsible for the grim situation. Their customers, the chip makers that fuel the boom-and-bust cycle with their unpredictable ordering patterns and their lack of cooperation with suppliers, are heavily at fault. And there are basic structural business problems in the semiconductor industry itself, which are



Top semiconductor equipment manufacturers

nobody's fault but nevertheless require a lot more attention from users and vendors.

The ultimate irony

"We've been saying it for years, you've got to run a business along responsible financial lines," says G. Daniel Hutcheson, president of VLSI Research Inc., a Silicon Valley consulting firm. "Unfortunately, everybody's off chasing technology trying to leapfrog the next person, and costs have risen beyond their ability to pay for it. The ultimate irony is that U.S. users keep demanding new leading-edge technologies and when they see the bill they won't pay for it. Technology is like bread. If it isn't supported by a viable business plan, it goes stale."

Industry observers believe that what will eventually pull the U.S. survivors through the recession are not grandiose technological innovations — such as larger silicon wafer sizes and complex automation schemes — government funding, or cooperative research and development projects, but a transition from a technology-driven to a cost-driven industry. Such a move would make it possible to compete with an aggressive Japanese production equipment effort.

Indeed, the three-year recession did give Japanese equipment vendors, that are closely tied to giant semiconductor companies in Japan, either through ownership or tight partnership, a leg up in this country. In the equipment segments targeted by Japan, it has made significant market share gains. Dataquest estimates that the Japanese share of the optical lithography market in the United States rose from 1% in 1983 to 28% in 1985, with Nikon Precision Inc. having 23% and Canon U.S.A. Inc., 5%. In dry-etching equipment, Japanese sales here went from zero in 1983 to 5% in 1985 — $8 million of a $170 million market. In electron beam photomask-making equipment and in scanning electron microscopes, the Japanese also picked up sizable market share here, says Dataquest.

Alexander Cutler, president of Eaton Corp.'s Industrial Group, a leader in ion implantation equipment, notes that it has always been the onset of next-generation chips that has pulled the equipment industry out of recession. Development costs, meanwhile, kept rising, and equipment prices skyrocketed as a result. Today it can take up to $30 million to bring an advanced lithography, implant, or test system to market. A single piece of gear can cost upward of $2 million. "That cycle is coming to an end as the industry evolves from an entrepreneurial to a mature environment," Cutler explains. "It's a natural evolution and you're seeing a lot of companies recognizing the importance of better business management."

> **"We had a high-risk strategy of trying to throw money at these projects to make a technological breakthrough that would give us market position. It didn't pan out and the only thing to do was fold it"**
>
> Alexander Cutler, president of Eaton Corp.'s Industrial Group

Eaton itself, according to Cutler, recognized that transition late last year when it closed most of its semiconductor equipment lines, including wafer steppers (which expose circuits on a wafer) and automatic test equipment. "We had a high-risk strategy of trying to throw money at these projects to make a technological breakthrough that would give us market position. It didn't pan out and the only thing to do was fold it."

Among other large multiproduct semiconductor equipment firms, the same realization has taken hold. Perkin-Elmer Corp., the company that led the market last year with more than $260 million in sales, and is the

market leader in the microlithography segment, has focused resources on its mainstream optical and electron-beam wafer exposure machines and backed out of the plasma-etching and metal deposition equipment segments. Veeco Instruments Inc. recently pulled the plug on its ion implant business, in which it had never gained significant market share, to concentrate on its existing niches in semiconductor instruments and automatic guided vehicles for process automation.

"I wish back in 1984 somebody had told me about 1986"
Arthur del Prado, president, ASM

"We're trying to get back to areas where we have a No. 1 or 2 position, even if the markets are tiny," insists Edward Braun, executive vice president of Melville, New York-based Veeco, which has a $40 million annual business in semiconductor-related gear. "We've finally recognized you can't afford to be the No. 5 company in a $150 million market where it costs tens of millions to bring out a product. Yes, we're going to be a lot more conservative to remain a bottom line company. You'll see many other divestitures throughout the industry for the same reason."

Horace McDonell, chairman and chief executive of Norwalk, Connecticut-based Perkin-Elmer, suggests equipment makers were too quick to "believe their own publicity" after the big growth spurt that saw worldwide industry revenue soar from $3.34 billion in 1983 to $6.3 billion in 1984. "Our goals were unrealistic," says McDonell. "But I'm proud that we were among the first to say that the king has no clothes."

High marks for PE

Nearly three years ago Perkin-Elmer began to contain costs and reduce levels of management and staffing across the entire company (PE is a major player in the analytical instrument and government markets), because it believed that profit margins were not keeping pace with sales gains. Last year, the Semiconductor Equipment Group earned $21.4 million, nearly 9% of net sales. A January charge relating to a write-off of etching equipment clouds the profit picture for this year, but analysts credit PE with superb balance sheet management. Where they are critical is in the company's shifting key resources from its successful lithography business (projection mask aligners and electron-beam equipment) to support a struggling plasma systems business, and in PE's failure to recognize critical marketing trends.

For example, the company had the opportunity in the late 1970s to get into the wafer stepper business. At the time, PE had only projection aligners, which expose an entire wafer at one time (whereas steppers expose wafers by "stepping" from die to die). Steppers have since supplanted projection machines at many fabrication plants and PE didn't enter that market until it bought a European manufacturer, Censor, in 1984. PE's share of the worldwide stepper market in 1986 was only 15%, according to VLSI Research.

McDonell confesses to errors in judgment ("management without error is a contradiction in terms," he says), specifically giving the marketing side of Perkin-Elmer short shrift. "Our history suggests that technology is where we excel," concludes the PE chairman. "But there are new realities. Because we're smart in one field doesn't mean we're smart in another. We're going to run our business with an element of restraint and not get caught up in the kind of euphoria that saw 50 companies in the etch business [go under] . . . at least we haven't hit the financial wall."

Would that other major equipment suppliers could say the same, but a large number are so pressed for cash that a further delay in the anticipated industry recovery, beyond 1987, could be disastrous.

Advanced Semiconductor Materials International Inc., a Netherlands-based public firm, is one example of a relatively small company (its 1986 sales, not yet reported, will be about $150 million) that is sitting with some very attractive technologies and some serious balance sheet woes. As of Sept. 30, 1986, ASM had a bulging debt-to-equity ratio of 0.86:1, after three consecutive years of losses. For the nine months ended in September, the company lost $22 million on sales of $105 million. Essentially, the company got caught in a double squeeze. While it was expanding through acquisition and internal development into three major new markets — ion implant, epitaxial reactors for complementary metal-oxide (CMOS) chips, and wafer steppers — the public equity markets were drying up, forcing the firm to take on a heavy debt load.

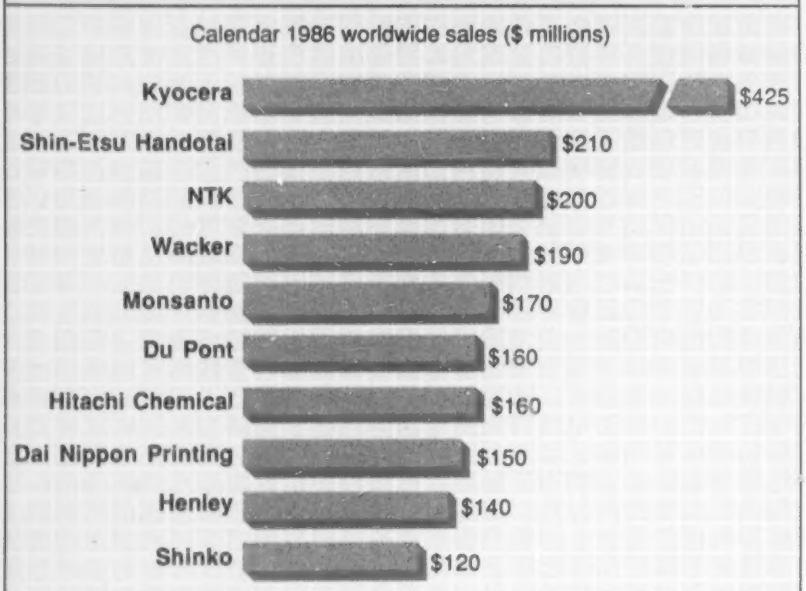
"It was terrible timing," says a former ASM executive. "Obviously it would make more sense to issue stock and perhaps their financial management was wrong, but strategically they were right. They have excellent products which technologically have the chance to give them strong market share, and they have solid global objectives. But will they survive is the big question."

Arthur del Prado, the peripatetic president of ASM, whose mainstream businesses are IC assembly equipment and chemical vapor deposition systems, calls 1987 the "survival year," acknowledging that he is nervous about his company's finances. However, del Prado expects an infusion of additional cash, partially in the form of new bank debt, which he believes will see the company through until its new products are established in the marketplace. "We can manage," he says. "But I wish back in 1984 somebody had told me about 1986. We extended more than we were ready for."

"We've finally recognized you can't afford to be the No. 5 company in a $150 million market where it costs tens of millions to bring out a product"
Edward Braun, executive vice president, Veeco Instruments

Indeed, the failure of the equipment industry to forecast the downturn was probably the single biggest reason for its current problems. Sadly, bad forecasting is largely a structural problem, endemic to the semiconductor business. In essence, semiconductor manufacturers and their vendors operate on widely different cycles. The chip maker plans his business three months ahead with only a one-month firm commitment on purchases, while the equipment vendor is on a six-month cycle. The equipment supplier must begin ordering inventory and putting it through the manufacturing pipeline

Top 10 semiconductor materials manufacturers



six months before shipment. In 1985, when so many semiconductor houses cancelled or stretched out their orders for equipment, their suppliers were stuck with millions of dollars in work-in-process inventory and couldn't shut off the flow.

Nevertheless, a number of equipment vendors that suffered through the inventory headache are finding creative ways to forecast more effectively. Kulicke & Soffa Industries Inc., a Willow Grove, Pa., manufacturer of assembly equipment, saw its sales plummet from $125 million in fiscal 1985 (ended in September) to about $60 million last year. Donald VanLuvanee, a former manager at Texas Instruments Inc. who has been K&S president since the downturn's start, says the company was in close contact with major customers and relied heavily on customer data to formulate K&S's business plan. "We were guilty of not developing our own forecasting tools . . . . If I believe the market is going to grow to three times its present size by 1990, I have the responsibility to critically judge that forecast because we simply don't have the ability to protect our backlog."

K&S is currently creating its own forecasting models, compiling its own data on such issues as factory utilization and spare parts usage. For example, last spring many in the industry were heralding an upturn. "Had we carefully tracked the spares business," says VanLuvanee, "we would have seen last May that all the users were doing was cannibalizing old machines to [retrofit new ones]."

GCA Corp., a manufacturer of wafer steppers in Andover, Mass., was nearly driven out of business by poor forecasting. While the worldwide stepper market in 1985 was collapsing, falling 25% from $543 million to $408 million, GCA was ramping up to increase sales from about 300 machines to 500 machines and hoped to compete not only in steppers, but in advanced robotics and factory automation systems. Marketing managers, who petitioned top management to scale back its forecasts, were reportedly ignored. GCA, which owned the stepper market in the early 1980s, shipped barely 100 systems in 1985. Today, the company has a negative net worth of $12 million, after losing more than $100 million over the past two years. Present management, which was brought in to rescue the stepper maker, describes the situation as a "mess."

Peter Simone, president of the beleaguered company, says GCA's financial plight has forced it to take a harder look at its mainstream market. "We've got to look at the market with some level of reality. We know a big year will be: 600 units shipped worldwide." In that vein, GCA is trying to get a handle on its inventories and costs. "To deal with the problem of cyclicality," Simone adds, "we've begun making more of a commitment to our own suppliers . . . . We pay a lot more attention to our vendors, and in one critical manufacturing area, lenses, we have Tropel, our own company, supplying our requirement." Simone says longer term, sole-source arrangements with suppliers will allow GCA to be more flexible in responding to order cutbacks. Meanwhile, with an upcoming rights offering and an equity placement expected to raise a total of $72 million, GCA officials believe they will have enough resources to carry their new Model 8500 stepper to market. Several industry analysts think GCA has worked many of the bugs out of its system and could be a formidable competitor once again. Simone says GCA simply needs to establish "credibility" with its customers to get back in the game.

Still another major problem for vendors in the recession: how to take some of the enormous costs out of research and development. John Halter, senior vice president for operations for General Signal's IC equipment business, sees this as crucial to the survival of his group of small systems houses. GS basically operates its 19 semiconductor equipment and materials companies as autonomous entities. R&D costs, says Halter, must be spread throughout the entire organization to realize economies of scale. "We can't afford so much duplication of effort," he says. GS in the last year has changed other elements of its IC equipment strategy. Where once it had hoped to be the "one-stop shop" for all equipment needs, today Halter acknowledges that the cost of trying to be all things to all people is too high. Advises Halter, "You can't operate like a discount department store. We are specialists."

In 1983-1984, when larger equip-

"Had we carefully tracked the spares business, we would have seen last May that all the users were doing was cannibalizing old machines to [retrofit new ones]"

Donald VanLuvanee, president, Kulicke & Soffa

ment companies were eyeing massive diversification into new markets, General Signal's laissez-faire management style was roundly criticized. In the current environment, industry observers suggest GS's organization may be more in tune with what the market really requires: flexibility. Notes VLSI Research's president Daniel Hutcheson, "The big equipment companies, like Eaton, made two classic mistakes a few years ago. They were slow to make decisions and adopted big company management styles to run a cottage industry."

George Rutland, the president of Ultratech Stepper, one of General Signal's larger equipment units, concurs. "You really can't find any multiproduct equipment company now that is benefiting from being heavily centralized. If we had to appeal to corporate in Connecticut every time we made a decision, we couldn't react fast enough. Bigness brings complexity and can cause you to lose your focus."

Applied Materials Inc., one of the more successful semiconductor equipment makers during the recession — it earned $9.3 million on sales of $175 million in 1985 — made that mistake in the early 1980s when it tried to expand into the wafer exposure market through the acquisition of Computervision's Cobilt division. However, the mistake turned into a godsend. The manufacturing space that Applied acquired from Cobilt allowed the maker of etching, implant and epitaxial equipment to meet demand during the 1983-1984 frenzy. Today, according to president James Morgan, Applied is playing it closer to the vest, diversifying into thin film processing technologies where it can leverage its experience in automation and in reducing contamination.

"Our goals were unrealistic . . . but we were among the first to say that the king has no clothes"

Horace McDonell, chairman, Perkin-Elmer

Morgan talks about the need to design products for manufacturability, a problem that has plagued many in the industry. "Everything has to work in sync," he says. "You need reasonable specifications, good design engineering aimed at producibility, and working together with your materials management, forecasting and marketing." Morgan notes that in a market like dry etch equipment, populated by 40 or 50 vendors, product differentiation is absolutely essential. Applied's first etch system, when it was introduced in 1981, brought an entirely new batch processing technology to the market. "A lot of companies exhibited some very bad business judgment in their product marketing strategies," he concludes.

In addition to undifferentiated products, analysts cite other common mistakes: making formal product announcements before the product is ready to ship, and failing to support equipment after the sale. "Our goals were unrealistic . . . but we were among the first to say that the king has no clothes," says Horace McDonell, chairman of Perkin-Elmer Corp. "We announced a machine that was not ready to ship, and we paid the price."

Perkin-Elmer's problems with its optical lithography equipment are well documented. Its first machine, the 500 series, was introduced in 1982 and was plagued with problems. Perkin-Elmer has since introduced the 600 series, which has been more successful, and the 700 series, which is still in development. McDonell says that Perkin-Elmer has learned from its mistakes and is now concentrating on the 700 series. "We're not announcing it until it's ready to ship," he says.

Perkin-Elmer has also learned the importance of customer support. "We've had to put a lot of resources into customer support," says McDonell. "We've had to put a lot of people in the field to keep the machines running."

Applied Materials has also had to put a lot of resources into customer support. Morgan says that the company has had to increase its service staff from 100 to 400 people in the last two years. "We've had to put a lot of people in the field to keep the machines running," he says.

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Meeting your customers halfway

Two years ago, Advanced Micro Devices Inc. chief executive Jerry Sanders threw the book at his American equipment suppliers in a much-publicized speech in Texas. Sanders accused IC equipment makers of shipping unreliable products and providing poor support. The speech was a watershed in the equipment industry, prompting many systems houses to question their business practices. Today, suppliers say they have made great strides in improving quality and they challenge their customers to meet them halfway — to put their money where their mouth is.

"In Japan, semiconductor companies have recognized the strategic importance of their suppliers, and they are willing to invest in them, like NEC in Nikon," says Daniel Hutcheson of VLSI Research Inc. "But you don't see TI or Motorola doing the same with their U.S. suppliers, nor do you see U.S. companies investing in new technology. In 1980 and 1981 when GCA was breaking through with wafer stepper technology, 60% of their sales were in Japan. Then semiconductor people here scratch their heads and ask what is happening to our technology base."

Hutcheson says U.S. device makers have pushed their suppliers to build advanced equipment and neglected basics like safe operation and ease of use. "The equipment grew more inflexible and complex and users only talked about wanting something flashy, a new Ferrari with a V-12. What they needed, but wouldn't talk about, is a Toyota with seats in the back."

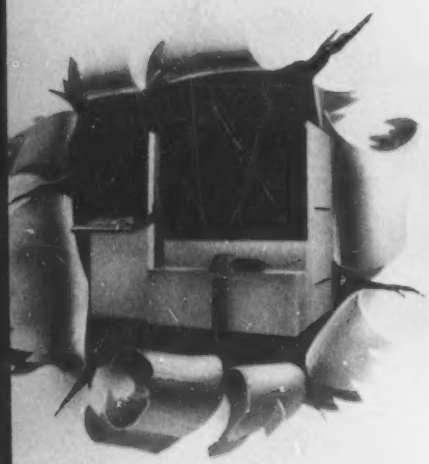
Equipment makers further accuse their customers of the following: subjecting vendors to drawn-out and ultimately fruitless product evaluations; preventing their vendors from playing a role in implementing the process on the shop floor; and paying lip service to "buy American" while purchasing Japanese products on the basis of lower price.

"Jerry Sanders was playing a card," says John Halter, senior vice president for General Signal Corp.'s semiconductor equipment unit, voicing a common complaint. "We ship a vanilla machine which the user takes and modifies for his own process. When he's through, you couldn't recognize the system. A year later, he tells you your equipment doesn't work."

Jonathan Golovin, president of Consilium Associates Inc., a maker of computer-integrated manufacturing software, says it is impossible for equipment companies to continue funding new products without assurance that customers will share the cost. He says long-term business relationships between vendor and user are one solution, but adds, "A major restructuring is going on, which is shrinking the number of people we sell to. Our semiconductor customers in this environment are in no rush to spend."

Some U.S. IC makers are beginning to respond to equipment makers' demands. Intel Corp., for example, has launched a "supplier motivation program," and its goal is to shift the focus off the giant technology breakthrough and toward improving system uptime, throughput and yield. Keith Erickson, director of materials for Intel, admits that the company has pushed new technology and neglected these essentials. Specifically, Intel has been in the forefront of the drive to six-inch wafers. Now, says Erickson, "We'd like to see someone else move it to eight inch." He adds that under the new supplier program, it is likely Intel will have to provide some "guarantees" on future equipment purchases. □

The ASET 948 SLR®– the i-line wafer stepper ideal for gallium arsenide.



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- Uniformity of illumination of ±3% at the wafer plane

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ASET

American Semiconductor Equipment Technologies

nouncements months or years before the product has even gone through systems integration, let alone beta siting; and rushing in with new technologies that are years ahead of the market. The areas of direct-write electron-beam and X-ray lithography — techniques for exposing circuits on wafers using focused electrons and X-rays — are classic examples. A number of companies, including General Signal, Micronix Corp., Perkin-Elmer and Varian Associates spent vast sums bringing these advanced systems to market, while manufacturers of wafer steppers were extending the limits of their optical technology below one micron. Those gains in stepper performance have pushed the market window for X-ray and electron-beam out to the 1990s.

On top of this, U.S. equipment makers concede their systems are often not fit for use, compared with the process equipment of their Japanese competitors. This is a long-standing source of complaints within the user community. Kulicke & Soffa's VanLuvanee offers the following analogy: Japanese and American wristwatches, equally well made, but only the Japanese watch is designed for underwater use. "If you ever find yourself in a swimming pool," he says, "only the Japanese product will work. Their [wafer processing] equipment isn't necessarily better, but it's designed to be plugged in and operational in production."

Nevertheless, the recession in the Japanese semiconductor market — users there put a halt to capital equipment purchases two years ago — has likewise devastated Japanese equipment vendors. "If Nikon were a U.S. company," argues Gary Hillman, president of Machine Technology Inc., a U.S. supplier of photoresist processing equipment, "they'd be in as big trouble as their American competitors. We never talk about that, we just flagellate ourselves. But the fact is the Japanese market is in terrible shape, they still primarily get our technology and copy it, and we're much more active in their market than they are in ours."

"We've got to look at the market with some level of reality"
Peter Simone, president, GCA

In fact, there are indications that Japanese equipment vendors in this country are beginning to focus less on gaining market share at any price and more on fundamental business issues. A source close to Nikon Precision says "they are restructuring with an idea not to go after market share but work harder on their existing service organization." Michael Powell, newly named marketing manager at Nikon Precision, denies the company is scaling back its stepper marketing program here, but he notes the company is trying to expand its stepper image-processing technology into such new markets as flat panel displays and printed circuit boards. In so doing, Nikon is following the lead of such American firms as Consilium Associates Inc. and KLA Instruments Corp., which have decided to use their semiconductor technology as a wedge into new industries.

A tighter organization

Canon, meanwhile, has also tightened its organization in the recession. The stepper maker, which also produces copiers, cameras and other products, was aggressive in going after U.S. market share, reportedly installing more than half of its U.S. machines on a consignment, rather than on a sales, basis. "Everything we build now is on order," says a Canon source, who asked not to be identified. "We are also trying to forecast demand better and not build inventory. But it's like the old saying, 'Forecasting next year's sales is like the fire chief telling the mayor which houses will be on fire next year.' Managing our business is tough."

Stephen Balog, an analyst at Prudential Bache Inc., sees the Japanese suffering in the automatic test equipment business, as well, noting that Advantest Corp.'s sales are off 44% (in yen) in the first half of its fiscal year, ended last September. "No doubt about it, the Japanese are getting hammered all over," he says. "Nikon isn't what it used to be, they're pulling back. But the problems of a lot of smaller U.S. companies are much worse. You can't run debt up to your eyelids and carry big losses year after year. We are looking at one more year of hell. The tanks are empty and there's still a whole lap to go. When I look at all the smaller companies in deep trouble and the bigger companies who can't keep compromising the rest of their profits, I see a semiconductor equipment industry that's in big trouble structurally." □

Semiconductor fabrication

Equipment markets and leaders

Deposition

Chemical vapor

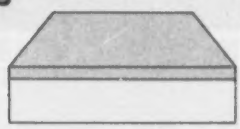
20% Advanced Semiconductor Materials
10% TEL-Thermco

$230

Physical vapor

20% Varian
15% Materials Research

$283

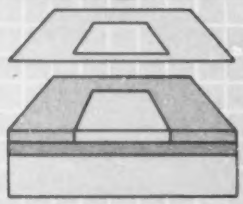


(includes all alignment systems and spin/bake process equipment)

Microlithography

25% Perkin-Elmer
20% Canon

$873



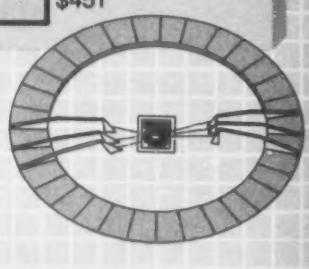
Raw silicon and wafer making

(includes mask and wafer inspection systems)

Process diagnostics

15% KLA Instruments
5% Nanometrics

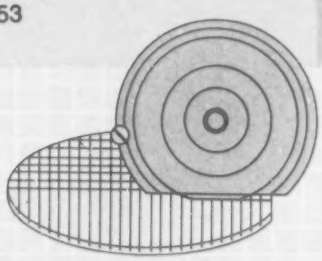
$451



Dicing saws

70% Disco
10% General Signal

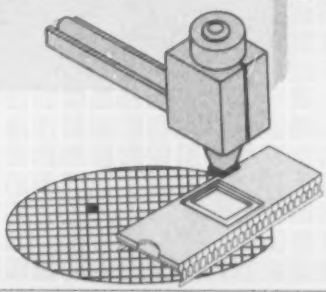
$53



Die bonders

16% Shinkawa
15% Esec

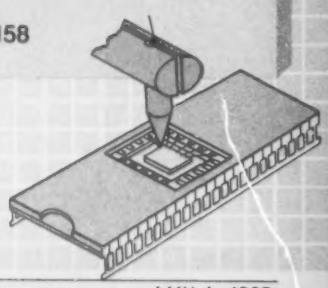
$67



Wire bonders

35% Kulicke & Soffa
30% Shinkawa

$158



1986 market

Equipment

Equipment
- Leaders, market share*
- Estimated worldwide sales** ($ millions)

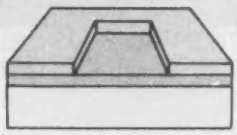
Equipment

- Wafer processing
- Questor systems***
- Assembly

Dry etching

20% Applied Materials
10% LAM Research

$376



(includes factory management software and CAE systems)

Factory management systems

25% Calma (GE)
10% Schlumberger

$302

Diffusion furnaces

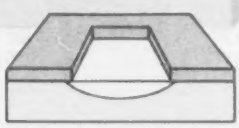
25% TEL-Thermco
15% Bruce

$203

Ion implantation

30% Varian
30% Eaton

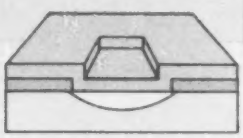
$178



Epitaxy

30% Applied Materials
10% Gemini

$171



(includes VLSI, memory, linear and logic testers)

Automatic test

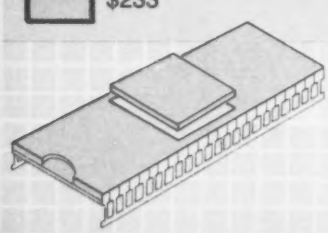
20% Advantest
10% Schlumberger
10% Teradyne

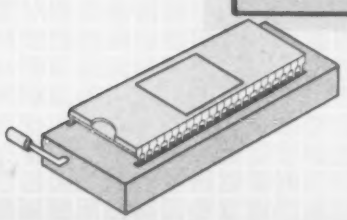
$1,144

Packaging

15% Yamada
15% Towa

$233





* Market share rounded to the nearest 5%

** Worldwide sales are for fiscal 1986

***Questor systems: Diagnostic, inspection, test and factory management systems

Source: VLSI Research Inc.

DOMINICAN REPUBLIC

Contact: Arturo Peguero, Counselor of Commercial Affairs

Address: Dominican Republic Embassy, 1715 22nd Street N.W., Washington, D.C. 20008

Phone: (202) 332-6280

HAITI

Contact: Harold Joseph, Commercial Attaché

Address: Embassy of Haiti, 2311 Massachusetts Avenue N.W., Washington, D.C. 20008

Phone: (202) 332-4090

JAMAICA

Contact: Audley Shaw, Director

Address: Jamaica National Investment Promotions, 866 Second Avenue, New York, N.Y. 10017

Phone: (212) 317-4800

NETHERLANDS ANTILLES

Contact: Carlos Romer, General Manager

Address: Curinde, Emancipatie Boulevard 7, Curacao, Netherlands Antilles

Phone: 011-559-9-76000

ST. LUCIA

Contact: Patrick Sylvester, Director

Address: St. Lucia National Development Corp., 41 East 42nd Street, Suite 315, New York, N.Y. 10017

Phone: (212) 867-2952

TRINIDAD and TOBAGO

Contact: Cathy Deosaran

Address: Trinidad and Tobago Industry Development Corp., 400 Madison Avenue, New York, N.Y. 10017

Phone: (212) 755-9360

CENTRAL and SOUTH AMERICA

ARGENTINA

Contact: J. Anderson

Address: Argentine Embassy Commercial Office, 900 Third Avenue, 4th floor, New York, N.Y. 10022

Phone: (212) 759-6477

BOLIVIA

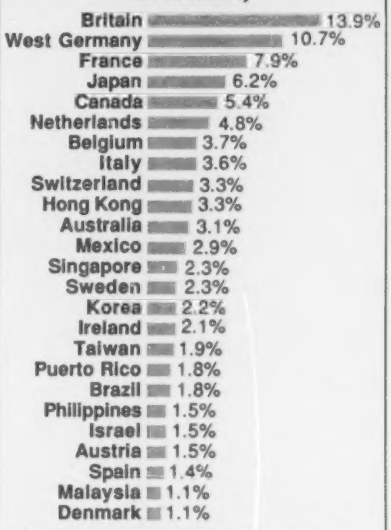
Contact: Edgar Bernal, Economic Counselor

Address: 3014 Massachusetts Avenue N.W., Washington, D.C. 20008

Phone: (202) 483-4410

Top 25 most commonly selected areas for international plant sites and facilities

Percentage of respondents to AEA survey



Figures are derived from a 1984 survey of the American Electronics Association's 2,700 member companies. Over 270 companies responded, giving the survey a 10% response rate.

Source: American Electronics Association

BRAZIL

Contact: Sergio B. Serra, Director

Address: Brazilian Government Trade Bureau, 551 Fifth Avenue, Room 210, New York, N.Y. 10176

Phone: (212) 916-3200

CHILE

Contact: ProChile

Address: 360 Madison Avenue, 13th floor, New York, N.Y. 10017

Phone: (212) 980-3366

COLOMBIA

Contact: Enrique Umana, Director

Address: Colombian Government Trade Bureau, 250 Park Avenue, New York, N.Y. 10177

Phone: (212) 972-7474

COSTA RICA

Contact: Rodrigo Sotela, Minister of Economic Affairs

Address: 1825 Connecticut Avenue N.W., Suite 213, Washington, D.C. 20009

Phone: (202) 234-2945

GUYANA

Contact: Winston Murray, Minister of Trade and Tourism

Address: Ministry of Trade, Main Street, Georgetown, Guyana

Phone: 011-592-2-68695

PANAMA

Contact: Ivonne Ruiz

Address: National Investment Council of Panama, 2355 Salzedo, Suite 208, Coral Gables, Fla. 33134

Phone: (305) 446-3343

PARAGUAY

Contact: Paraguay Promotion Center - CEBEX

Address: Avva. Espana 374, Asunción, Paraguay

Phone: 011-595-2-08880

Telex: 259 PYMIC

PERU

Contact: Miguel Vega Alvear

Address: Sociedad Nacional de Industrias, Los Laureles 365, San Isidro, Lima, Peru

Phone: 011-51-140-8700

Telex: 21030

URUGUAY

Contact: Tomas Garrido, Director

Address: Uruguayan Government Trade Bureau, 747 Third Avenue, 37th floor, New York, N.Y. 10017

Phone: (212) 751-7137, 7138

VENEZUELA

Contact: Venezuelan Consulate Public Relations

Address: 7 East 51st Street, New York, N.Y. 10022

Phone: (212) 826-1660

EUROPE

AUSTRIA

Contact: Karl Schmidt

Address: Austrian Trade Commission, 845 Third Avenue, 21st floor, New York, N.Y. 10022

Phone: (212) 421-5250

BELGIUM

Contact: Patrick Everarts de Velp, Commercial Attaché

Address: Embassy of Belgium, 3330 Garfield Street, Washington, D.C. 20008

Phone: (202) 333-6900

DENMARK

Contact: Leif Wasserman, Commercial Attaché

Address: Consulate General of Denmark, 825 Third Avenue, New York, N.Y. 10022

Phone: (212) 223-4545

FINLAND

Contact: Esa Seppala, Trade Commissioner

Address: Trade Commission of Finland, 540 Madison Avenue, New York, N.Y. 10022

Phone: (212) 832-6550

Fastest growing firms: Life in the fast lane

On average, lead U.S. disk drive supplier sales surged 33% over the past five years

By Al Furst and Linda Stallmann

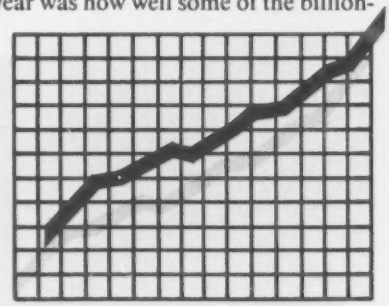
Riding the crest of the wave in distributed computing, which swept across the United States in the first half of this decade, the fastest-growing disk drive makers and other peripherals manufacturers recorded a torrid 33.8% compound annual growth rate from fiscal 1981 to 1986.

Our annual analysis of the 100 fastest growing companies in the United States also showed that four of the top 10 leaders in this category were disk drive makers — Miniscribe Corp. of Longmont, Colo., the fastest growing company overall which posted a phenomenal 369.5% five-year compounded growth rate; Seagate Technology of Scotts Valley, Calif., which clocked in at 115.9%; Priam Corp. of San Jose, Calif., at 84.7%; and Micropolis Corp. of Chatsworth, Calif., at 54.9%.

Also, with the exception of Priam, which recently experienced a $31 million write-off in excess equipment, all four of those companies also performed reasonably well in the most recent financial quarters, both from the standpoint of sales and profitability. Micropolis ended fiscal 1986 with $18.3 million in net profits, up from $2.7 million the previous year, on $213 million in sales, up from $94.9 million in 1985. Miniscribe posted year-end earnings of $22.7 million, up from a loss of $16.7 million the previous year, on sales of $184.9 million, which was up from $114 million in 1985. And in the first six months of fiscal 1987, ended Dec. 31, Seagate showed $62.1 million in earnings, versus $6.2 million for the comparable period in 1986, while sales soared to $440.9 million, from $191.3 million.

As with three-quarters of the companies we looked at in our top 100 list, all four of the disk drive companies also had sales of under $500 million during this period. This phenomenon — smaller companies growing at a more robust rate than larger ones — is not unusual because high-tech start-ups (starting from the ground up) usually have a more rapid ramp-up than the industry giants.

But what was also surprising this year was how well some of the billion-dollar companies performed over the past five years. Apple Computer Inc., which — last time we looked — was still a glamour stock on Wall Street, posted a 41.5% growth rate from 1981 to 1986; Wang Laboratories Inc., which has been battered in the past year by the computer slowdown, still managed a 25.3% growth rate; and Digital Computer Corp., which is increasingly stealing IBM's thunder — not to mention its sales and salesmen — notched up a respectable 18.9% compounded annual growth rate.



What was surprising was how well some of the billion-dollar companies performed

Other members of the billion-dollar clubs which made this year's fastest-growing list include Amp Inc., Data General Corp., E-Systems Inc., Harris Corp., Hewlett-Packard Co., IBM, Intel Corp., Motorola Inc., N.A. Philips Corp., Tandy Corp., Xerox and Zenith Electronics Corp. It is noteworthy, however, that newly formed Unisys Corp. — which grew out of the highly touted merger last year between Burroughs Corp. and Sperry Corp. — did not make the list this year. Unisys may be the second largest computer company in the United States, after IBM, but using sales over a five-year period as a measure of growth, the company did not measure up. In fact, Burroughs and Sperry on a prorated basis posted a 0.4% decline in growth over the five-year period under analysis.

In order for a firm to qualify for our annual list, it must meet four criteria: it must be a publicly held U.S.-based company; its 1986 revenue must total $100 million or more; its electronics revenue, as defined by our research staff, must make up at least 70% of total revenue (software and service firms are excluded, this is why Microsoft Corp. and AT&T never make our list); and it must have recorded at least five years worth of revenue.

This last criterion — five years of revenue — is the reason why our selections did not include companies in the number of red-hot industry areas, notably workstations and computer-aided engineering, which (with the possible exception of No. 3 ranked Apollo Computer Inc.) are conspicuously absent from our list. If the start-ups in those areas were included, as many no doubt will be next year, they — and not disk drive makers — would have probably topped our annual fastest growing list. □

Fastest growing companies

Rank	Company	Sales growth (5-year compounded annual rate)	Fiscal 1986 revenue ($ millions)	Fiscal 1986 profits ($ millions)	Fiscal year ended (month/year)	Location
1	**MiniScribe**	369.5%	$184.9	$22.7	12/86	Longmont, Colo.
2	**VLSI Technology**	189.1%	111.7	0.1	12/86	San Jose, Calif.
3	**Apollo Computer**	158.4%	391.7	9.3	12/86	Chelmsford, Mass.
4	**Seagate Technology**	115.9%	459.8	34.5	6/86	Scotts Valley, Calif.
5	**Convergent Technologies**	87.8%	305.8	-32.8	12/86	San Jose, Calif.
6	**Priam**	84.7%	128.8	0.1	6/86	San Jose, Calif.
7	**Digital Communications**	69.8%	137.9	20.6	6/86	Alpharetta, Ga.
8	**Western Digital**	63.5%	279.4	27.8	6/86	Irvine, Calif.
9	**Emulex**	59.9%	104.9	7.5	6/86	Costa Mesa, Calif.
10	**Micropolis**	54.9%	213.1	18.3	12/86	Chatsworth, Calif.
11	**DSC Communications**	53.5%	304.0	11.0	12/86	Plano, Texas
12	**SCI Systems**	51.3%	470.2	13.8	6/86	Huntsville, Ala.
13	**Xebec**	51.0%	115.5	-3.5	9/86	San Jose, Calif.
14	**Cipher Data Products**	48.2%	163.0	7.2	6/86	San Diego, Calif.
15	**Intelligent Systems**	46.2%	125.5	0.0	3/86	Norcross, Ga.
16	**Intergraph**	46.1%	605.7	70.4	12/86	Huntsville, Ala.
17	**Emerson Radio**	45.2%	566.3	12.9	3/86	North Bergen, N.J.
18	**Altos Computer Systems**	44.4%	134.2	20.3	6/86	San Jose, Calif.
19	**Xidex**	42.6%	432.3	32.2	6/86	Mountain View, Calif.
20	**Cray Research**	42.5%	596.7	124.8	12/86	Minneapolis, Minn.
21	**Cincinnati Microwave**	42.4%	102.1	11.5	12/86	Cincinnati, Ohio
22	**Apple Computer**	41.5%	1,901.9	154.0	9/86	Cupertino, Calif.
23	**Micom Systems**	39.1%	189.5	12.7	3/86	Simi Valley, Calif.
24	**ISC Systems**	38.7%	166.1	13.9	6/86	Spokane, Wash.
25	**NBI**	37.4%	282.4	-4.2	6/86	Boulder, Colo.
26	**Timeplex**	34.5%	119.1	9.6	6/86	Woodcliff Lake, N.J.
27	**Tandon**	31.6%	214.1	-62.8	9/86	Chatsworth, Calif.
28	**Decision Industries**	31.2%	195.1	7.8	11/86	Horsham, Pa.
29	**Telex**	30.6%	709.2	67.5	3/86	Tulsa, Okla.
30	**Tandem Computers**	29.8%	767.8	63.8	9/86	Cupertino, Calif.
31	**Bolt Beranek and Newman**	26.5%	178.0	11.3	6/86	Cambridge, Mass.
32	**Electrospace Systems**	26.1%	145.0	13.4	3/86	Richardson, Texas
33	**Computer Products**	26.0%	111.4	-9.3	12/86	Pompano Beach, Fla.
34	**General DataComm Industries**	25.3%	178.0	3.9	9/86	Middlebury, Conn.
35	**Wang Laboratories**	25.3%	2,643.0	50.9	6/86	Lowell, Mass.
36	**Dynatech**	25.1%	256.7	20.4	3/86	Burlington, Mass.
37	**Anthem Electronics**	23.6%	104.5	3.1	3/86	San Jose, Calif.
38	**Diasonics**	23.5%	217.1	5.9	12/86	Milpitas, Calif.
39	**Loral**	22.8%	663.8	53.0	3/86	New York, N.Y.
40	**Monolithic Memories**	21.8%	204.9	8.9	9/86	Santa Clara, Calif.
41	**Logicon**	21.2%	200.5	10.0	3/86	Torrance, Calif.
42	**Avantek**	20.5%	208.2	16.1	12/86	Santa Clara, Calif.
43	**Printronix**	20.3%	131.9	-11.7	3/86	Irvine, Calif.
44	**Key Tronic**	20.3%	111.7	0.6	6/86	Spokane, Wash.
45	**DEC**	18.9%	7,590.4	617.4	6/86	Maynard, Mass.
46	**Prime Computer**	18.7%	860.2	46.9	12/86	Natick, Mass.
47	**Evans-Sutherland**	18.7%	109.3	10.9	12/86	Salt Lake City, Utah
48	**Marshall Industries**	18.3%	244.8	2.9	5/86	El Monte, Calif.
49	**AEL Industries**	17.0%	104.9	4.7	2/86	Lansdale, Pa.
50	**Amdahl**	16.9%	966.3	41.8	12/86	Sunnyvale, Calif.

Source: ELECTRONIC BUSINESS

(Continued)

Fastest growing companies (continued)

Rank	Company	Sales growth (5-year compounded annual rate)	Fiscal 1986 revenue ($ millions)	Fiscal 1986 profits ($ millions)	Fiscal year ended (month/year)	Location
51	Computer Consoles	16.6%	$129.6	-$3.0	12/86	Waltham, Mass.
52	Analog Devices	16.4%	334.4	23.4	10/86	Norwood, Mass.
53	Pioneer-Standard	16.4%	202.0	-2.0	3/86	Cleveland, Ohio
54	Data Card	16.3%	153.6	10.6	3/86	Minneapolis, Minn.
55	Nicolet Instruments	15.9%	126.4	2.9	3/86	Madison, Wis.
56	Gerber Scientific	15.5%	191.8	18.2	4/86	South Windsor, Conn.
57	Molex	15.3%	291.9	32.0	6/86	Lisle, Ill.
58	Adams-Russell Electronics	15.2%	113.1	6.7	9/86	Waltham, Mass.
59	Hewlett-Packard	15.0%	7,102.0	516.0	10/86	Palo Alto, Calif.
60	Coherent	14.7%	138.2	1.7	9/86	Palo Alto, Calif.
61	E-Systems	14.7%	1,135.1	61.6	12/86	Dallas, Texas
62	Watkins-Johnson	14.0%	255.4	17.2	12/86	Palo Alto, Calif.
63	Paradyne	14.0%	261.1	-37.6	12/86	Largo, Fla.
64	Applied Materials	14.0%	149.3	1.2	10/86	Santa Clara, Calif.
65	Teradyne	13.9%	306.1	0.2	12/86	Boston, Mass.
66	Applied Magnetics	13.6%	128.1	4.1	9/86	Goleta, Calif.
67	Advanced Micro Devices	13.2%	576.1	-36.6	3/86	Sunnyvale, Calif.
68	Siliconix	13.1%	111.2	7.4	12/86	Santa Clara, Calif.
69	Recognition Equipment	13.0%	241.8	9.0	10/86	Irving, Texas
70	Burr-Brown	12.9%	112.8	3.7	12/86	Tucson, Ariz.
71	California Microwave	12.9%	104.4	4.4	6/86	Sunnyvale, Calif.
72	Computervision	12.8%	494.7	-5.8	12/86	Bedford, Mass.
73	Tandy	12.4%	3,036.0	200.6	6/86	Fort Worth, Texas
74	Analogic	12.3%	148.2	10.1	7/86	Peabody, Mass.
75	Motorola	12.0%	5,888.0	194.0	12/86	Schaumburg, Ill.
76	IBM	12.0%	51,250.0	4,789.0	12/86	Armonk, N.Y.
77	Andrew	11.6%	197.7	9.5	9/86	Orland Park, Ill.
78	Data General	11.5%	1,268.0	5.7	9/86	Westboro, Mass.
79	Tracor	11.2%	632.1	18.8	12/86	Austin, Texas
80	MTS Systems	11.1%	109.8	6.9	9/86	Minneapolis, Minn.
81	Scientific-Atlanta	11.1%	469.1	-9.2	6/86	Atlanta, Ga.
82	Systems Industries	10.4%	103.3	3.1	7/86	Milpitas, Calif.
83	Cordis	10.3%	188.1	-2.9	6/86	Miami, Fla.
84	Unitrode	10.1%	168.0	9.2	1/86	Lexington, Mass.
85	Measurex	10.0%	192.7	21.1	11/86	Cupertino, Calif.
86	Intel	9.9%	1,265.0	-183.3	12/86	Santa Clara, Calif.
87	AVX	9.8%	195.4	-3.1	12/86	Great Neck, N.Y.
88	AMP	9.4%	1,933.0	164.0	12/86	Harrisburg, Pa.
89	Harris	9.3%	2,216.6	59.6	6/86	Melbourne, Fla.
90	Dataproducts	9.2%	353.8	-26.8	3/86	Woodland Hills, Calif.
91	Spectra-Physics	9.1%	210.1	0.8	9/86	San Jose, Calif.
92	Veeco Instruments	8.6%	167.8	0.4	9/86	Melville, N.Y.
93	Sun Electric	8.6%	177.0	1.9	10/86	Crystal Lake, Ill.
94	Arrow Electronics	8.5%	529.6	-28.3	12/86	New York, N.Y.
95	Fluke Manufacturing	8.4%	209.0	12.2	9/86	Everett, Wash.
96	Augat	8.4%	260.4	-8.7	12/86	Mansfield, Mass.
97	N.A. Philips	8.4%	4,531.6	81.2	12/86	New York, N.Y.
98	Xerox	8.2%	12,900.0	488.0	12/86	Stamford, Conn.
99	Zenith Electronics	8.2%	1,892.1	-10.0	12/86	Glenview, Ill.
100	Cubic	8.2%	337.8	1.1	9/86	San Diego, Calif.

Source: ELECTRONIC BUSINESS

(Continued)

Fastest growing companies in 1986 by industry segment

Five-year compounded annual rate

	Sales growth	Profit change	Rank
Capital equipment			
Nicolet Instruments	15.9%	-10.5%	55
Gerber Scientific	15.5%	+15.4%	56
Hewlett-Packard	15.0%	+11.1%	59
Applied Materials	14.0%	-8.3%	64
Teradyne	13.9%	-44.5%	65
Tracor	11.2%	-0.2%	79
Spectra-Physics	9.1%	-19.6%	91
Veeco Instruments	8.6%	-48.2%	92
Fluke Manufacturing	8.4%	+7.5%	95
Weighted average	**14.2%**	**+9.3%**	
Communications			
Digital Communications	69.8%	+207.4%	7
DSC Communications	53.5%	NM	11
Cincinnati Microwave	42.4%	+28.8%	21
Micom Systems	39.1%	+24.6%	23
Timeplex	34.5%	+37.7%	26
Bolt Beranek and Newman	26.5%	+64.5%	31
General DataComm	25.3%	+16.3%	34
Dynatech	25.1%	+30.8%	36
Avantek	20.5%	+11.1%	42
Adams-Russell Electronics	15.2%	+6.0%	58
Paradyne	14.0%	NM	63
California Microwave	12.9%	+11.9%	71
Motorola	12.0%	+2.1%	75
Andrew	11.6%	-0.7%	77
Scientific-Atlanta	11.1%	NM	81
Weighted average	**14.7%**	**+2.3%**	
Components			
VLSI Technology	189.1%	NM	2
Western Digital	63.5%	NM	8
Monolithic Memories	21.8%	+5.0%	40
Analog Devices	16.4%	+38.5%	52
Molex	15.3%	+14.9%	57
Advanced Micro Devices	13.2%	NM	67
Siliconix	13.1%	+125.2%	68
Burr-Brown	12.9%	+15.4%	70
Unitrode	10.1%	-2.5%	84
Intel	9.9%	NM	86
AVX	9.8%	NM	87
AMP	9.4%	+4.0%	88
Augat	8.4%	NM	96
Weighted average	**12.4%**	**-28.7%**	
Computers			
Apollo Computer	158.4%	NM	3
Convergent Technologies	87.8%	NM	5
SCI Systems	51.3%	+34.8%	12
Altos Computer Systems	44.4%	+53.5%	18
Cray Research	42.5%	+47.0%	20
Apple Computer	41.5%	+31.3%	22
Telex	30.6%	+52.9%	29
Tandem Computers	29.8%	+19.2%	30
DEC	18.9%	+12.5%	45
Prime Computer	18.7%	+4.5%	46
Amdahl	16.9%	+9.3%	50
Hewlett-Packard	15.0%	+11.1%	59
Tandy	12.4%	+3.4%	73
Analogic	12.3%	+2.8%	74
IBM	12.0%	+7.7%	76
Data General	11.5%	-32.4%	78
Weighted average	**14.1%**	**+8.9%**	

	Sales growth	Profit change	Rank
Computer-based systems			
Intergraph	46.1%	+53.5%	16
ISC Systems	38.7%	+25.5%	24
Computer Products	26.0%	NM	33
Evans-Sutherland	18.7%	NM	47
Computer Consoles	16.6%	NM	51
Data Card	16.3%	+12.5%	54
Coherent	14.7%	+1.3%	60
Recognition Equipment	13.0%	NM	69
Computervision	12.8%	NM	72
MTS Systems	11.1%	+14.3%	80
Measurex	10.0%	+58.6%	85
Sun Electric	8.6%	NM	93
Weighted average	**18.8%**	**+12.4%**	
Defense electronics			
Electrospace Systems	26.1%	+36.7%	32
Loral	22.8%	+18.7%	39
Logicon	21.2%	+27.5%	41
AEL Industries	17.0%	+33.6%	49
E-Systems	14.7%	+20.9%	61
Watkins-Johnson	14.0%	+20.9%	62
Motorola	12.0%	+2.1%	75
Harris	9.3%	-10.8%	89
Cubic	8.2%	-36.7%	100
Weighted average	**12.4%**	**+3.4%**	
Distributors			
Emerson Radio	45.2%	+119.9%	17
Anthem Electronics	23.6%	+7.4%	37
Marshall Industries	18.3%	NM	48
Pioneer-Standard	16.4%	NM	53
Arrow Electronics	8.5%	NM	94
Weighted average	**19.5%**	**NM**	
Office equipment			
NBI	37.4%	NM	25
Wang Laboratories	25.3%	-8.2%	35
IBM	12.0%	+7.7%	76
Harris	9.3%	-10.8%	89
Xerox	8.2%	-4.0%	98
Weighted average	**11.6%**	**+5.6%**	
Peripherals			
MiniScribe	369.5%	NM	1
Seagate Technology	115.9%	+82.9%	4
Priam	84.7%	NM	6
Emulex	59.9%	+42.9%	9
Micropolis	54.9%	+136.4%	10
Xebec	51.0%	NM	13
Cipher Data Products	48.2%	+144.7%	14
Intelligent Systems	46.2%	-53.9%	15
Xidex	42.6%	+36.6%	19
Tandon	31.6%	NM	27
Decision Industries	31.2%	+41.8%	28
Printronix	20.3%	NM	43
Key Tronic	20.3%	-31.6%	44
Applied Magnetics	13.6%	-23.9%	66
Systems Industries	10.4%	-7.5%	82
Dataproducts	9.2%	NM	90
Weighted average	**33.8%**	**-11.0%**	

NM = Not meaningful

Source: ELECTRONIC BUSINESS